Stoller
Hanford Office

DOE-EM/GJ689-2004

# 299-E25-08 (A6027)
## Log Data Report

## Borehole Information:

| **Borehole:** 299-E25-08 (A6027) | | | **Site:** 216-A-8 Crib | | |
|---|---|---|---|---|---|
| **Coordinates** (WA State Plane) | | **GWL (ft)[1]:** 263.2 | | **GWL Date:** 06/23/04 | |
| **North** | **East** | **Drill Date** | **TOC[2] Elevation** | **Total Depth (ft)** | **Type** |
| 136,190.035 m | 575,814.825 m | May 1956 | 202.476 m | 290 | Cable Tool |

## Casing Information:

| Casing Type | Stickup (ft) | Outer Diameter (in.) | Inside Diameter (in.) | Thickness (in.) | Top (ft) | Bottom (ft) |
|---|---|---|---|---|---|---|
| Welded steel | +2.3 | 6 5/8 | 6 1/8 | 1/4 | +2.3 | 237 |
| Welded steel | 0 | unknown | unknown | unknown | 0 | 290 |
| The logging engineer measured the casing stickup using a steel tape. A caliper was used to determine the outside casing diameter. The caliper and inside casing diameter were measured using a steel tape. Measurements were rounded to the nearest 1/16 in. Casing thickness was calculated. The 8-in. casing is not visible at the ground surface. | | | | | | |

## Borehole Notes:

Borehole coordinates, elevation, and well construction information are from measurements by Stoller field personnel, HWIS[3], and Ledgerwood (1993). Zero reference is the top of the 6-in. casing.

## Logging Equipment Information:

| **Logging System:** | Gamma 2A | | **Type:** 35% HPGe (34TP20893A) |
|---|---|---|---|
| **Calibration Date:** | 03/04 | **Calibration Reference:** | DOE-EM/GJ642-2004 |
| | | **Logging Procedure:** | MAC-HGLP 1.6.5, Rev. 0 |

## Spectral Gamma Logging System (SGLS) Log Run Information:

| Log Run | 1 | 2 | 3 | 4 | 5 / Repeat |
|---|---|---|---|---|---|
| Date | 06/21/04 | 06/22/04 | 06/23/04 | 06/24/04 | 06/25/04 |
| Logging Engineer | Spatz | Spatz | Spatz | Spatz | Spatz |
| Start Depth (ft) | 36.0 | 90.0 | 166.0 | 262.0 | 53.0 |
| Finish Depth (ft) | 3.0 | 35.0 | 89.0 | 165.0 | 19.0 |
| Count Time (sec) | 200 | 200 | 200 | 200 | 200 |
| Live/Real | R | R | R | R | R |
| Shield (Y/N) | N | N | N | N | N |
| MSA Interval (ft) | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| ft/min | N/A[4] | N/A | N/A | N/A | N/A |
| Pre-Verification | BA349CAB | BA350CAB | BA351CAB | BA352CAB | BA353CAB |
| Start File | BA349000 | BA350000 | BA351000 | BA352000 | BA353000 |

| Log Run | 1 | 2 | 3 | 4 | 5 / Repeat |
|---|---|---|---|---|---|
| Finish File | BA349033 | BA350055 | BA351077 | BA352097 | BA353034 |
| Post-Verification | BA349CAA | BA350CAA | BA351CAA | BA352CAA | BA353CAA |
| Depth Return Error (in.) | 0 | 0 | 0 | + 1 | 0 |
| Comments | Fine gain adjustment after files: -003, -013, -016, and -030. | Fine gain adjustment after files: -016 and -035. | Fine gain adjustment after files: -034, -048, -057, -067, and -073. | Fine gain adjustment after files: -042, -062, -077, and -088. | No fine gain adjustment. |

## Logging Operation Notes:

Zero reference was top of the 6-in. casing. Logging was performed without the centralizer on the sonde for spectral data collected on 06/24/04. Pre- and post-survey verification measurements for the SGLS employed the Amersham KUT ($^{40}$K, $^{238}$U, and $^{232}$Th) verifier with serial number 082. Maximum logging depth achieved was 262.0 ft, approximately 1 ft above groundwater.

## Analysis Notes:

| Analyst: | Henwood | Date: | 06/29/04 | Reference: | GJO-HGLP 1.6.3, Rev. 0 |
|---|---|---|---|---|---|

SGLS pre-run and post-run verification spectra were collected at the beginning and end of each day. All of the verification spectra were within the acceptance criteria.

Log spectra for the SGLS were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Verification spectra were used to determine the energy and resolution calibration for processing the data using APTEC SUPERVISOR. Concentrations were calculated in EXCEL (source file: G2AMAR04.xls), using parameters determined from analysis of recent calibration data. Zero reference was the top of the 6-in. casing. Based on Ledgerwood (1993), the casing configuration was assumed to be a string of 6-in. casing with a thickness of 1/4 in. to a log depth of 237 ft and a string of 8-in. casing with a thickness of 0.322 in. to the depth of 262 ft. The 6-in. casing thickness was measured by the logging engineer. A casing thicknesss of 0.322 in. was assumed for the 8-in. casing. This thickness is the published value for ASTM schedule-40 steel pipe, a commonly used casing material at Hanford. Where more than one casing exists at a depth, the casing correction is additive (e.g., the correction for both 6-in. and 8-in. casing would be 0.25 + 0.322 = 0.572). Water and dead time corrections were not required.

## Log Plot Notes:

Separate log plots are provided for gross gamma and dead time, naturally occurring radionuclides ($^{40}$K, $^{238}$U, and $^{232}$Th), and man-made radionuclides. Plots of the repeat logs versus the original logs are included. For each radionuclide, the energy value of the spectral peak used for quantification is indicated. Unless otherwise noted, all radionuclides are plotted in picocuries per gram (pCi/g). The open circles indicate the minimum detectable level (MDL) for each radionuclide. Error bars on each plot represent error associated with counting statistics only and do not include errors associated with the inverse efficiency function, dead time correction, or casing correction. These errors are discussed in the calibration report. A combination plot is also included to facilitate correlation. The $^{214}$Bi peak at 1764 keV was used to determine the naturally occurring $^{238}$U concentrations on the combination plot.

## Results and Interpretations:

$^{137}$Cs was the only man-made radionuclide detected in this borehole. $^{137}$Cs was detected at 5 ft, at approximately 22 ft, at a few sporadic locations throughout the borehole, and between 234 and 240 ft. The range of concentrations was from the MDL (0.2 pCi/g) to 4.5 pCi/g, which was measured at 5 ft. The $^{137}$Cs detected at log depths between 234 and 240 ft is located at a depth interval approximately 22 ft above the current groundwater level. It is possible that a groundwater mound existed in the area in the past and the $^{137}$Cs is a remnant of contaminated groundwater. The range of concentrations in the interval between 234 and 240 ft was from near the MDL to 2.5 pCi/g, which was measured at 237 ft.

The concentrations of the KUT above 240 ft appear to be underestimated due to the effects of double casing and grout.

The behavior of the $^{238}$U log suggests that radon may be present inside the borehole casing. Determination of $^{238}$U is based on measurement of gamma activity at 609 and/or 1764 keV associated with $^{214}$Bi, under the assumption of secular equilibrium in the decay chain. However, $^{214}$Bi is also a short-term daughter of $^{222}$Rn. When radon is present, $^{214}$Bi will tend to "plate" onto the casing wall and will quickly reach equilibrium with $^{222}$Rn. Because the additional $^{214}$Bi resulting from radon is on the inside of the casing, the effect of the casing correction is to amplify the 609 photopeak relative to the 1764 photopeak. (The magnitude of the casing correction factor decreases with increasing energy, but gamma rays originating inside the casing are not attenuated.) This effect is observed in log data acquired during logging runs 1 and 2 (3 to 90 ft). The effects of radon appear to be minimal in the other log runs. The reason for variations in radon content between log runs on successive days is not known. Variations in radon content in boreholes are probably related to variations in surface weather conditions. Radon daughters such as $^{214}$Bi may also "plate" onto the sonde itself. When this occurs, there is a gradual increase in total counts as well as photopeak counts associated with $^{214}$Bi and $^{214}$Pb.

The presence of radon is not an indication of man-made contamination; it is derived from decay of naturally occurring uranium. As a gas, radon moves easily in the subsurface, and concentrations of radon and its associated progeny can change quickly.

The plots of the repeat logs demonstrate reasonable repeatability of the SGLS data for the natural radionuclides (609, 1461, 1764, and 2614 keV energy levels).

Gross gamma logs from Additon et al. (1977) (attached) indicate that the sediments surrounding this borehole contained significant amounts of man-made gamma radiation extending to groundwater from 1958 through at least 1963. By 1976 most of the gamma activity in the vadose zone had decayed away.

## References:

Additon, M.K., K.R. Fecht, T.L. Jones, and G.V. Last, 1978. *Scintillation Probe Profiles From 200 East Area Crib Monitoring Well*s, RHO-LD-28, Rockwell Hanford Operations, Richland, Washington.

Ledgerwood, R.K., 1993. *Summaries of Well Construction Data and Field Observations for Existing 200-East Resource Protection Wells*, WHC-SD-ER-TI-007, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

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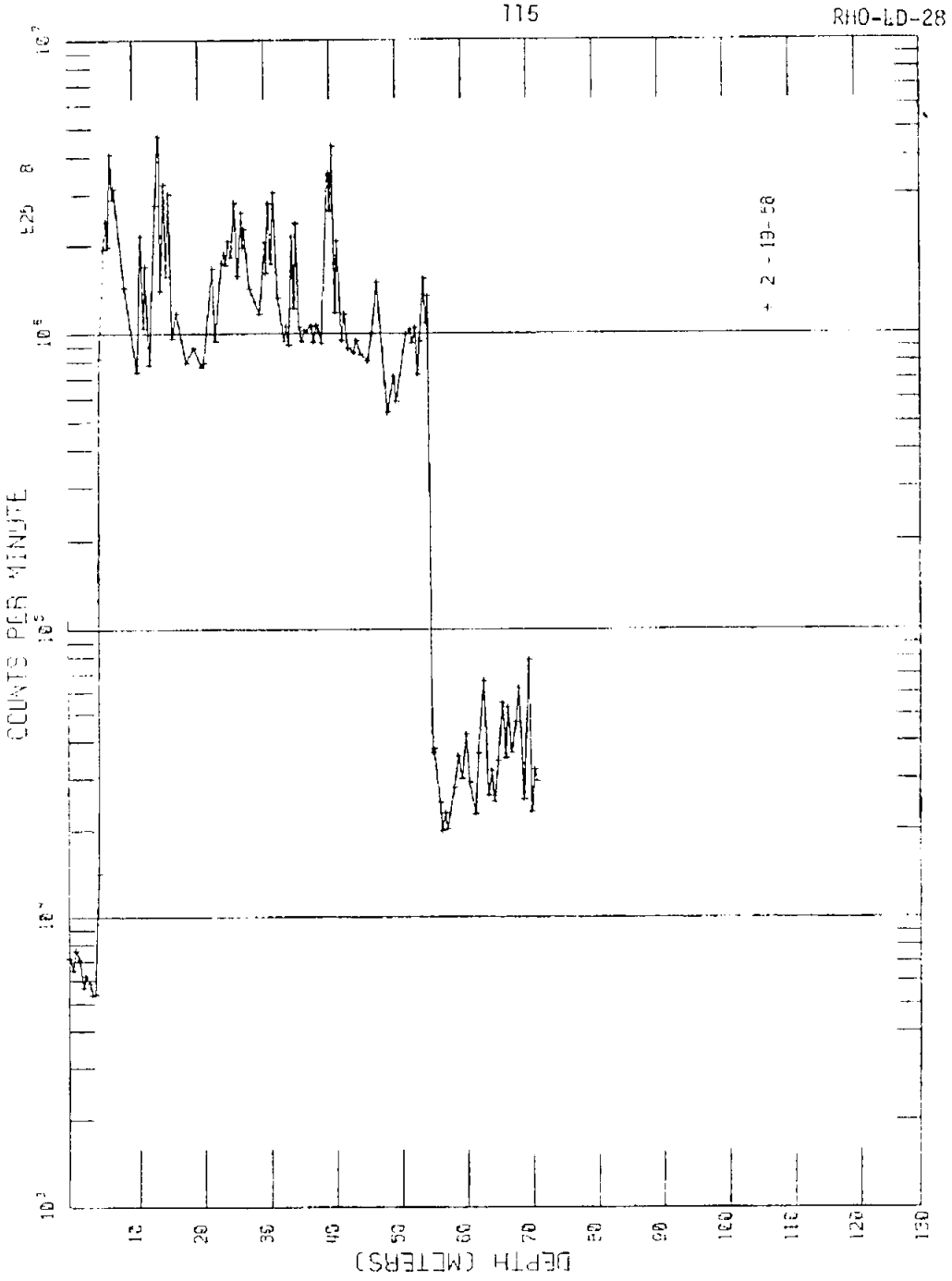
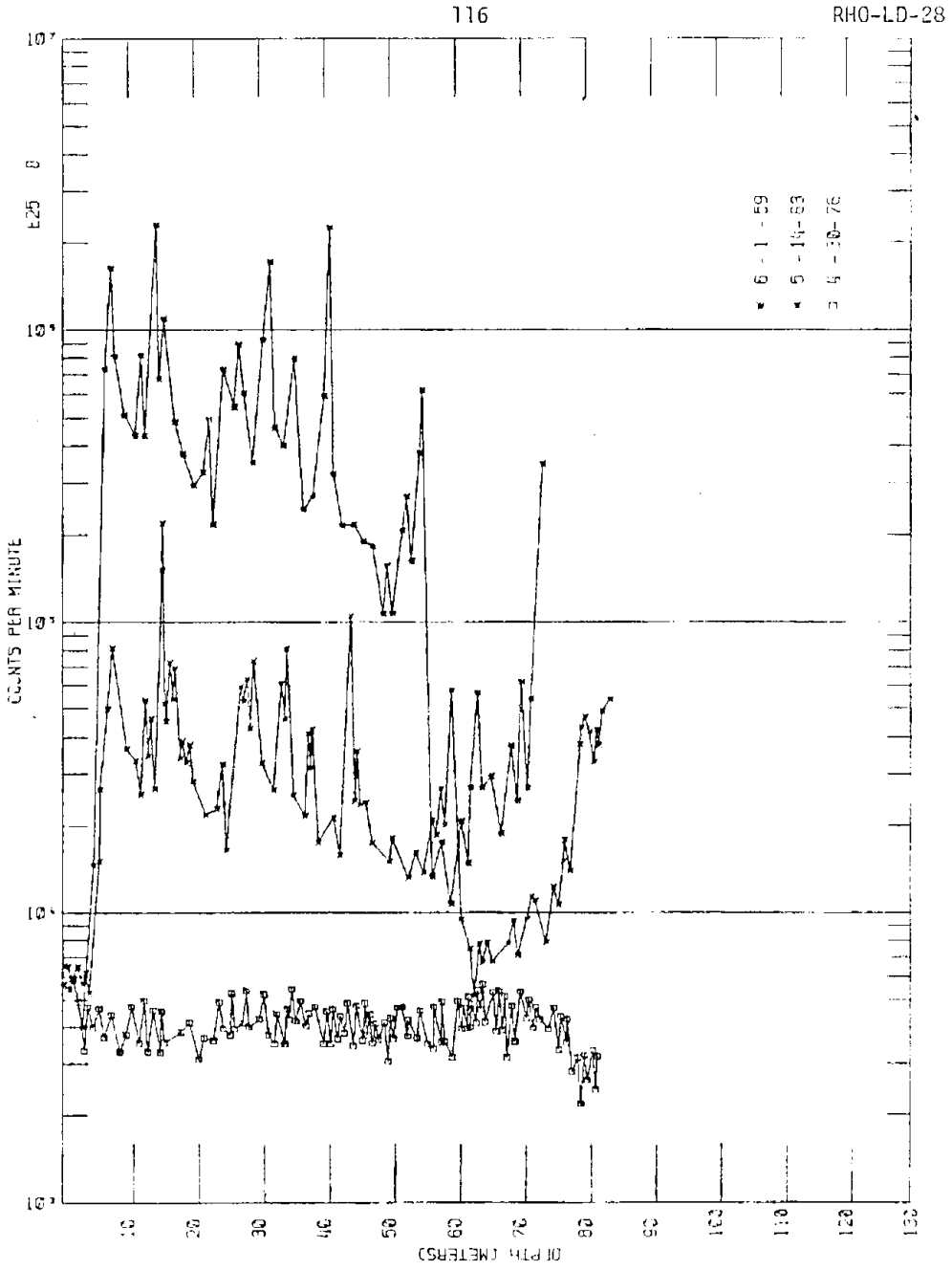
[1] GWL – groundwater level
[2] TOC – top of casing
[3] HWIS – Hanford Well Information System
[4] N/A – not applicable




from Additon et al. (1978)

*Scintillation Probe Profiles for Borehole 299-E25-8, Logged on 2/19/58*

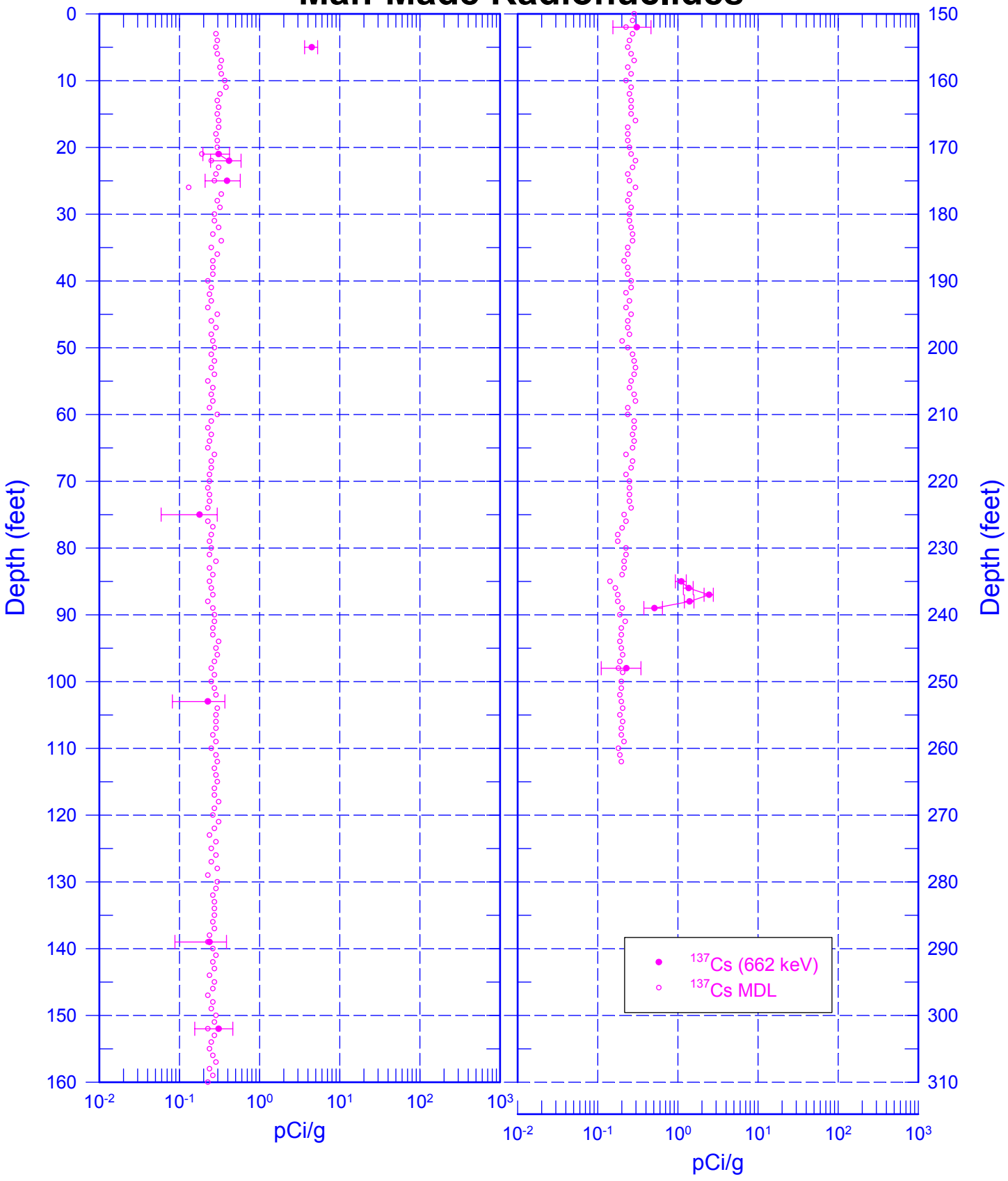



from Additon et al. (1978)

*Scintillation Probe Profile for Borehole 299-E25-8, Logged on 6/1/59, 5/14/63, and 4/30/76*

# 299-E25-08 (A6027)

## Man-Made Radionuclides



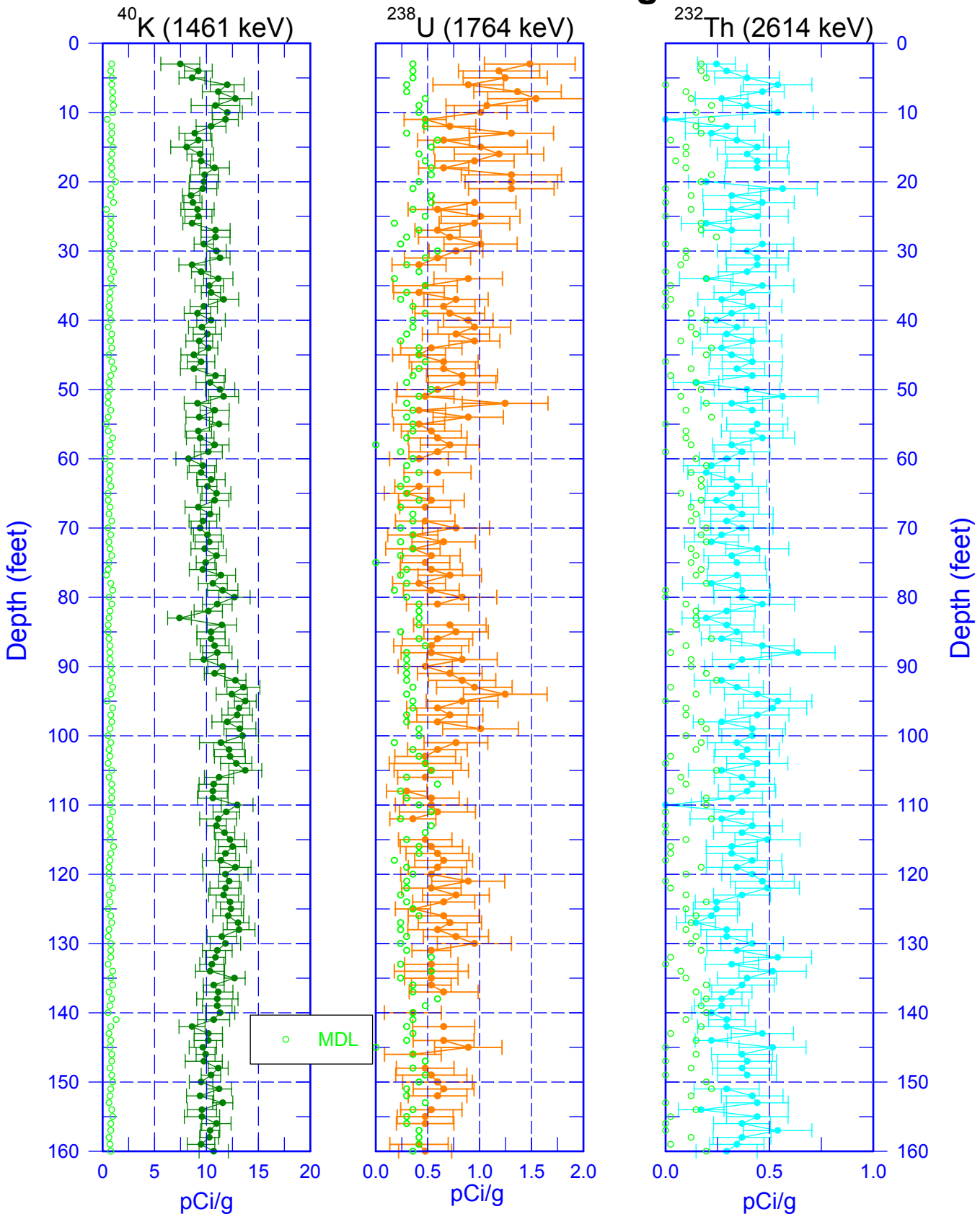

Zero Reference - Top of Casing

Depth scale: 1" = 20 ft

Last Log Date - 06/25/04

# 299-E25-08 (A6027)

## Natural Gamma Logs

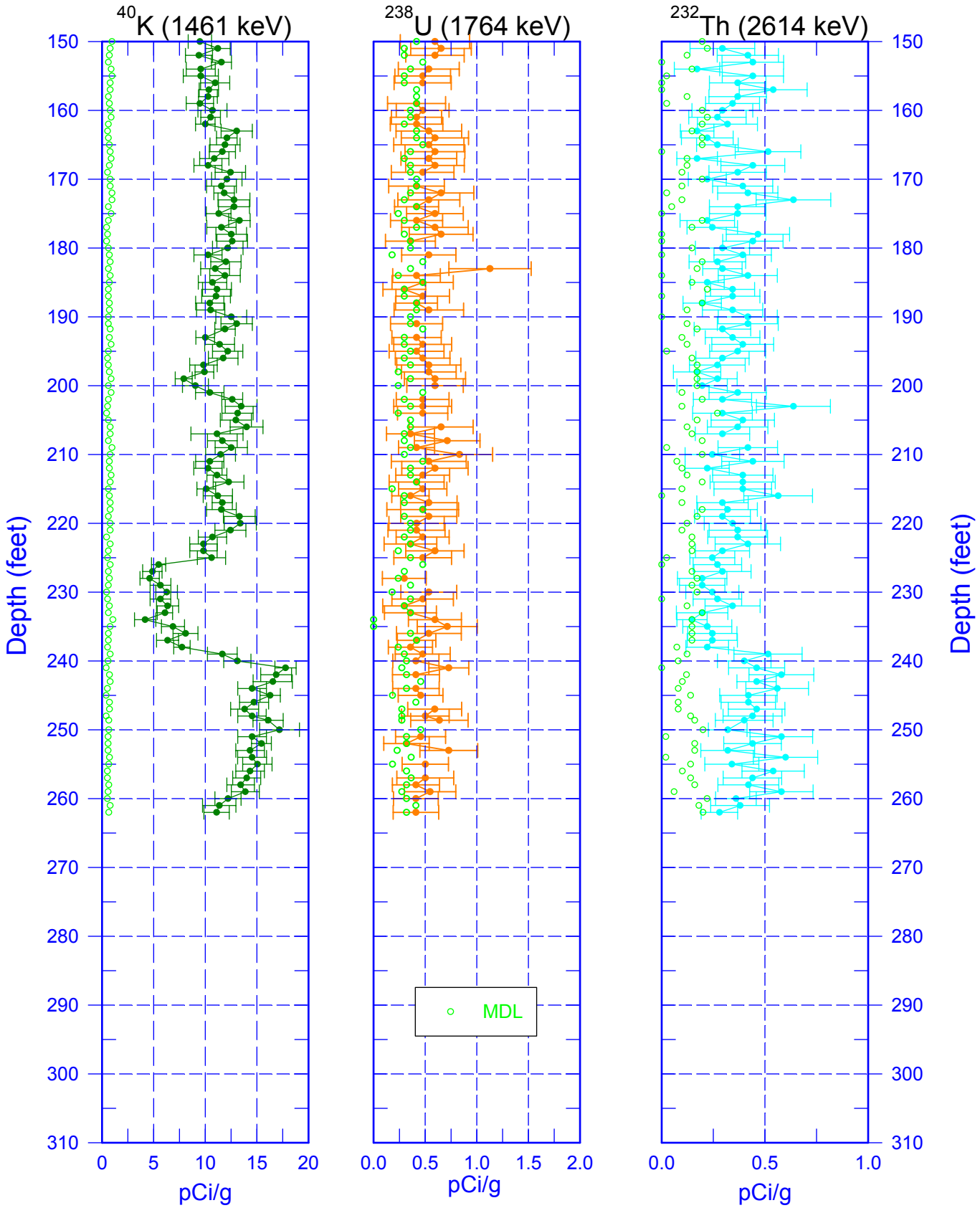



Zero Reference - Top of Casing

Depth scale: 1" = 20 ft

Last Log Date - 06/25/04

# 299-E25-08 (A6027)
## Natural Gamma Logs

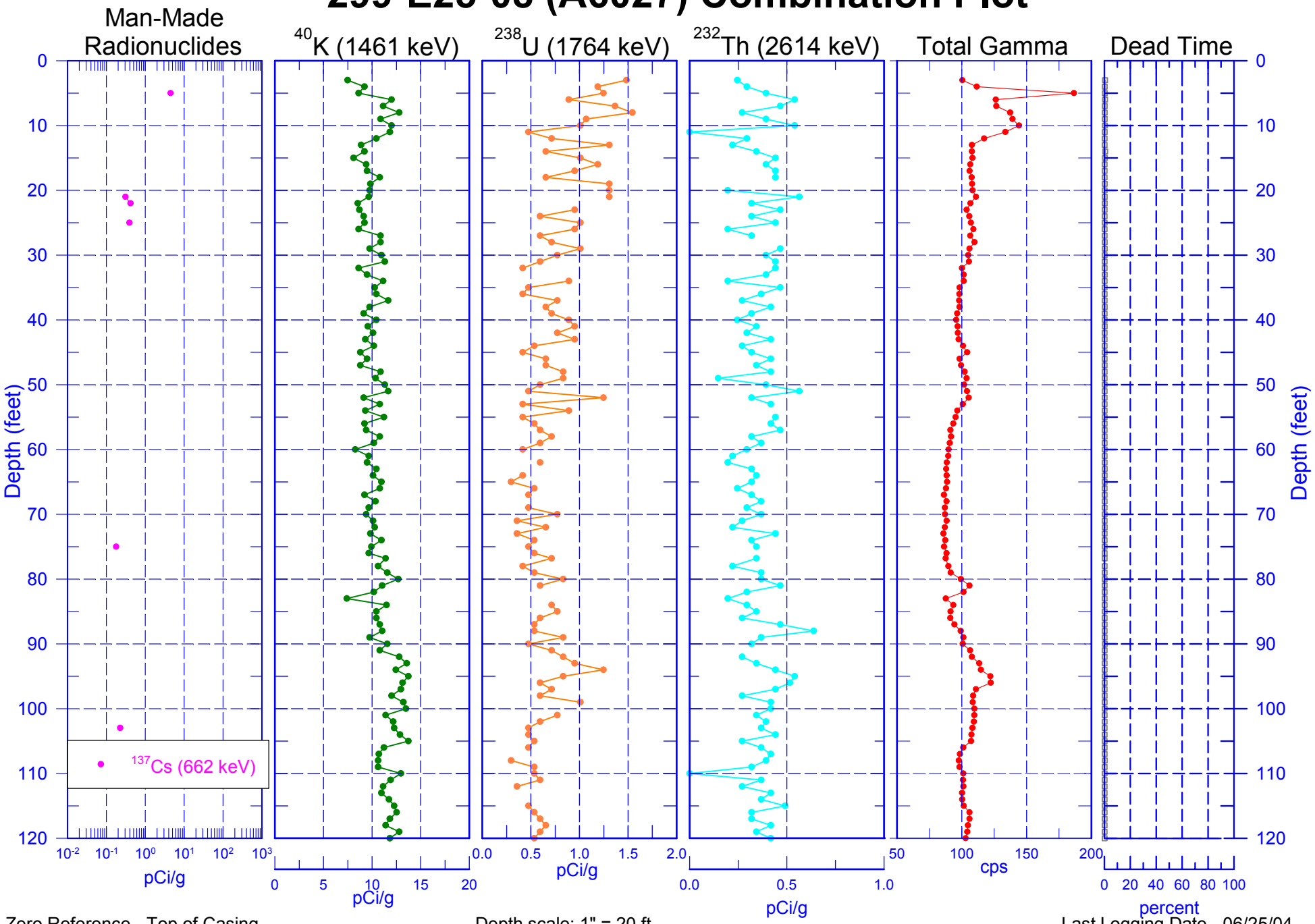



Zero Reference - Top of Casing

Depth scale: 1" = 20 ft

Last Log Date - 06/25/04

# 299-E25-08 (A6027) Combination Plot

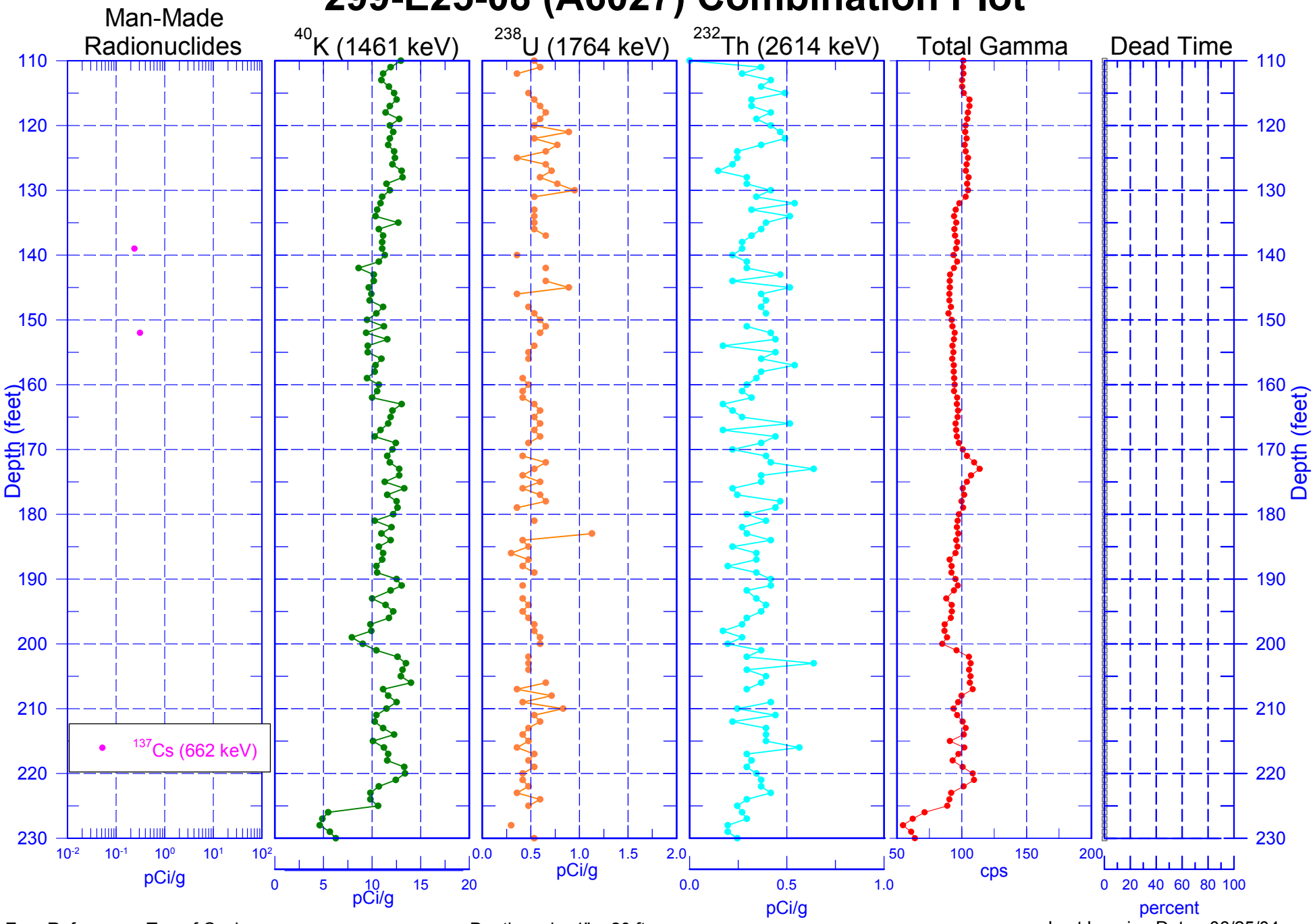



Zero Reference - Top of Casing

Depth scale: 1" = 20 ft

Last Logging Date - 06/25/04

# 299-E25-08 (A6027) Combination Plot

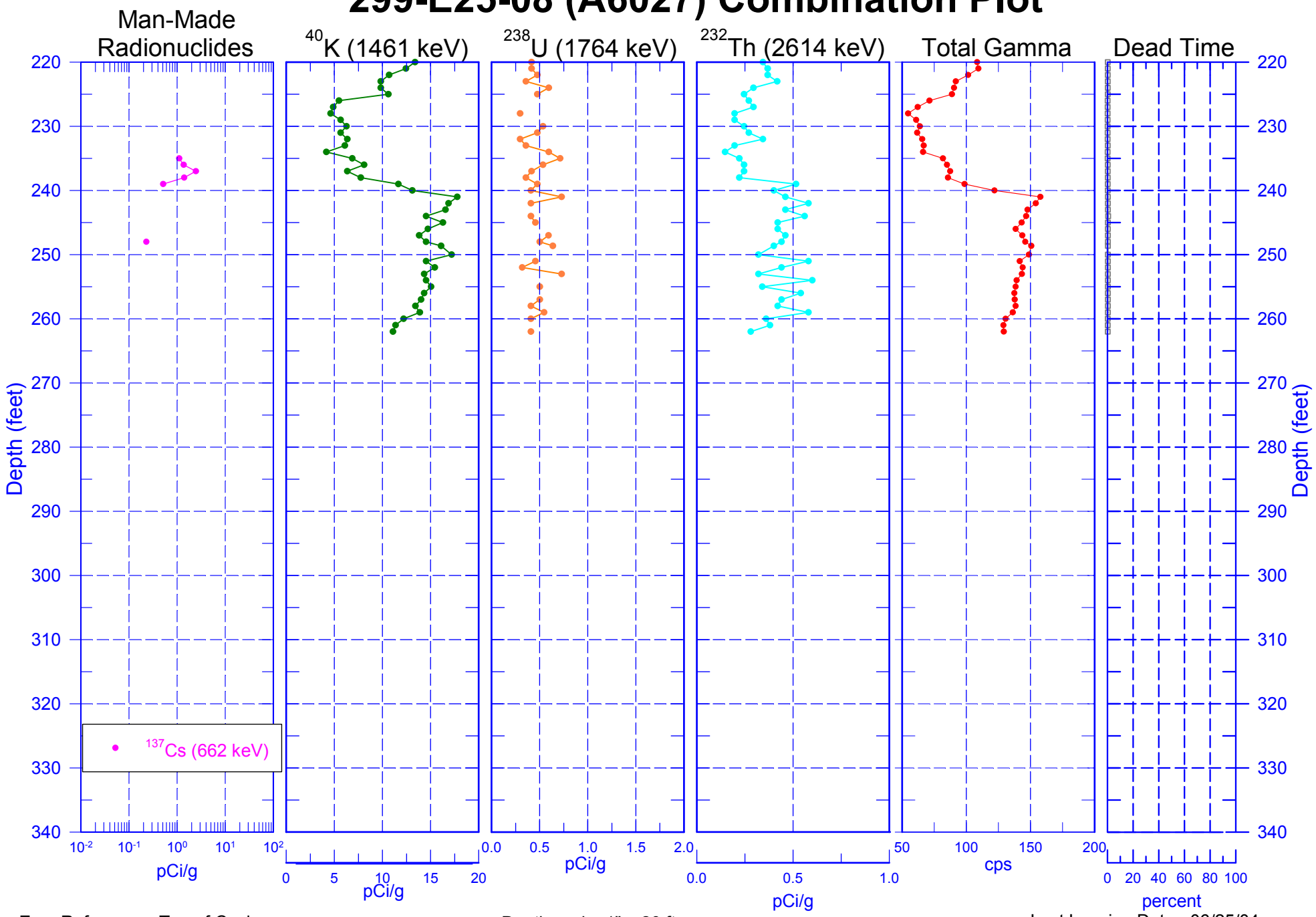



Zero Reference - Top of Casing

Depth scale: 1" = 20 ft

Last Logging Date - 06/25/04

# 299-E25-08 (A6027) Combination Plot

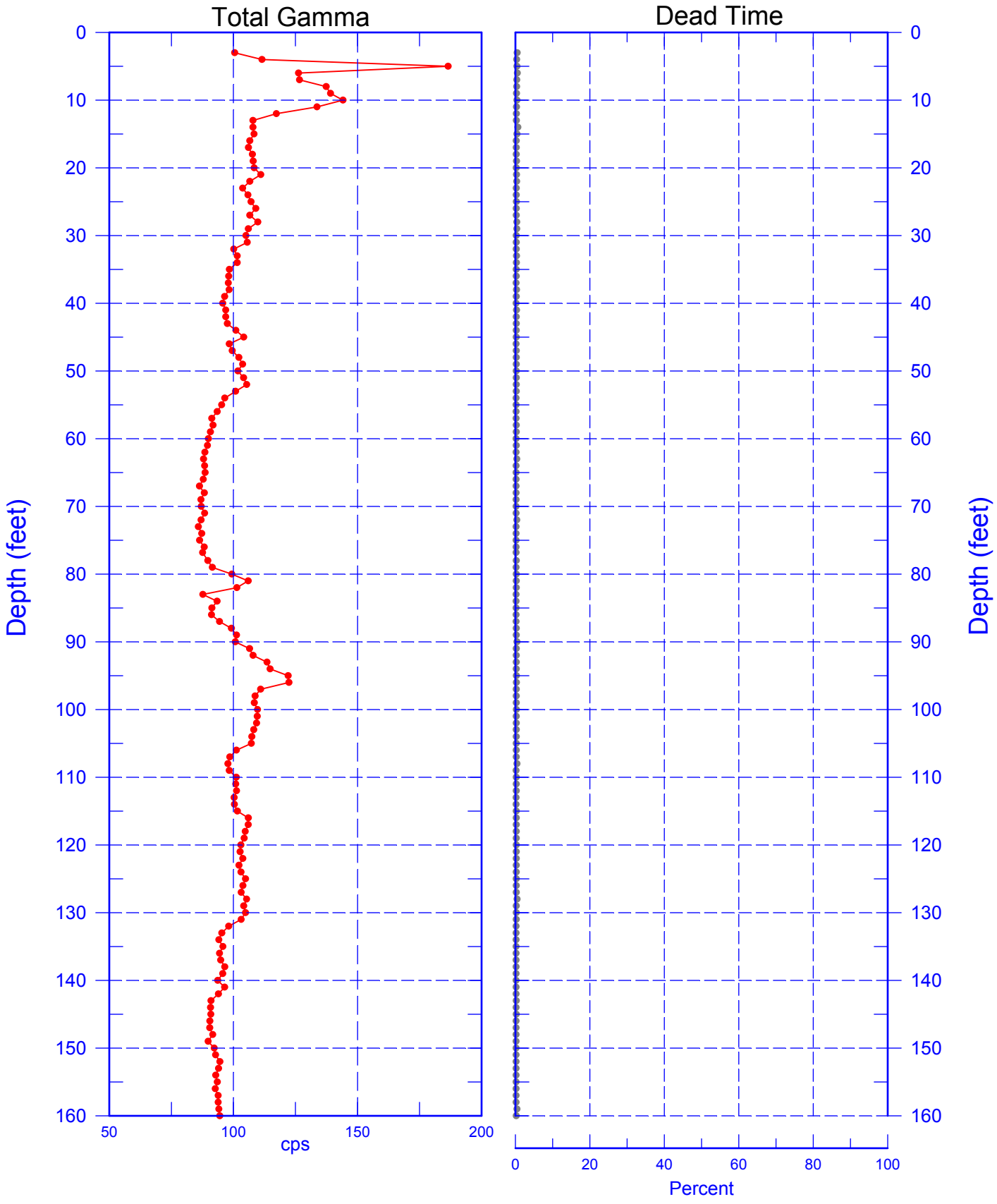



Zero Reference - Top of Casing

Depth scale: 1" = 20 ft

Last Logging Date - 06/25/04

# 299-E25-08 (A6027)
## Total Gamma & Dead Time

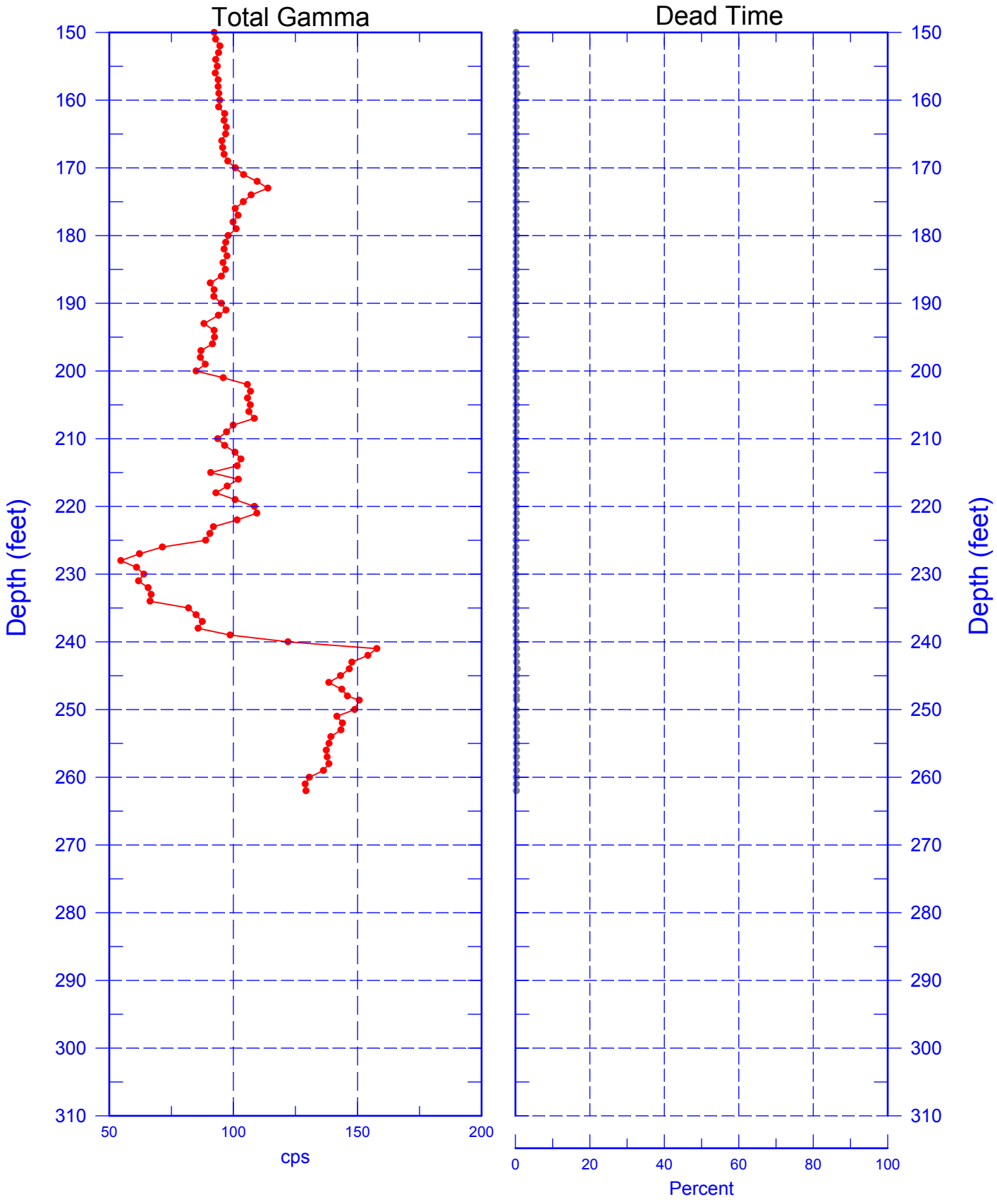



Reference - Top of Casing

Depth scale: 1" = 20 ft

Last Log Date - 06/25/04

# 299-E25-08 (A6027)
## Total Gamma & Dead Time



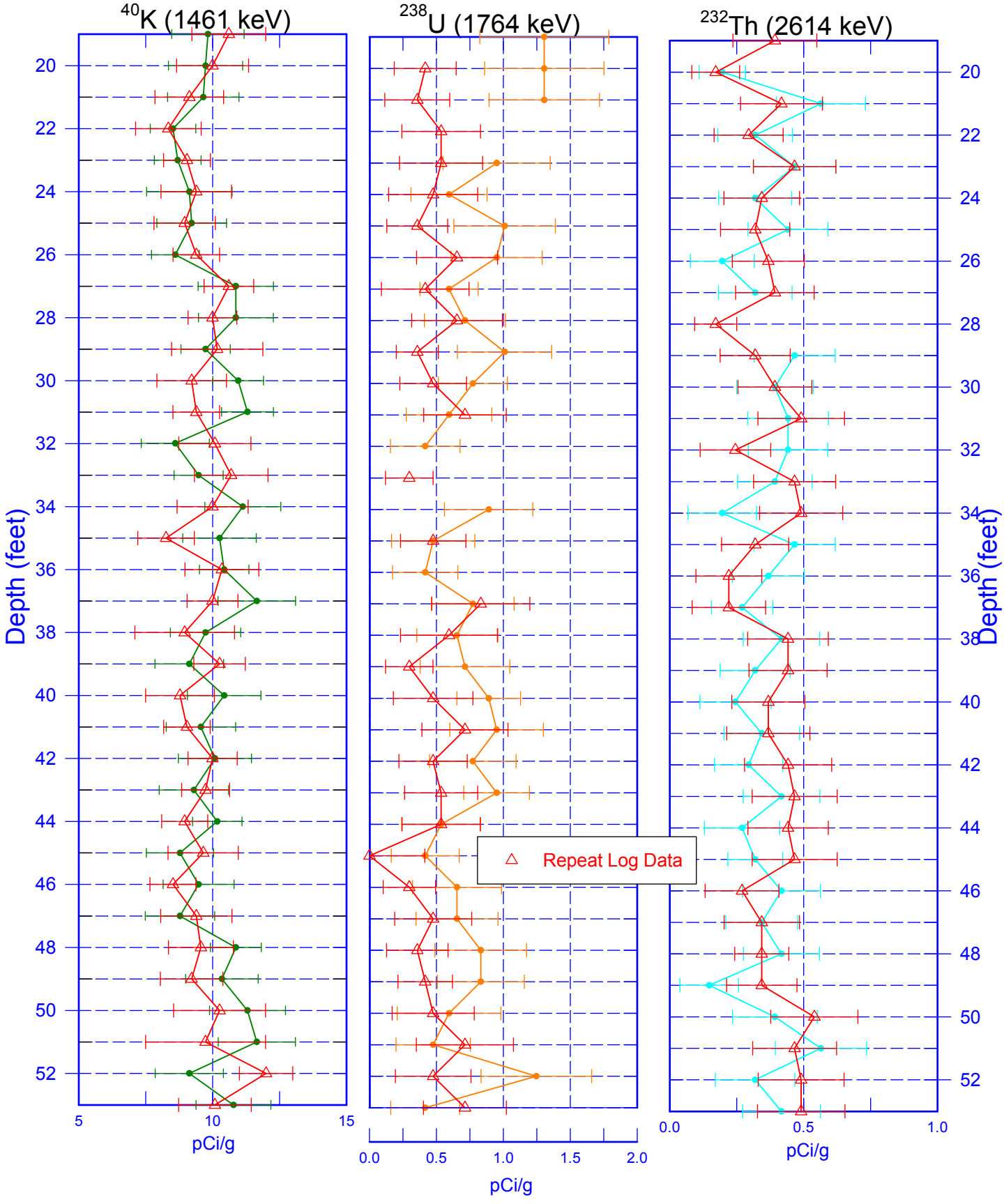

Reference - Top of Casing

Depth scale: 1" = 20 ft

Last Log Date - 06/25/04

# 299-E25-08 (A6027)

## Repeat Section of Natural Gamma Logs




Zero Reference - Top of Casing

Last Log Date - 06/25/04